U.S. DEPARTMENT OF COMMERCE
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PB-260 079

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ENVIRONMENTAL HEALTH CENTER, CINCINNATI, OHIO

1948

002097

PB 260 079

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BY

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NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

FEDERAL SECURITY AGENCY
U. S. PUBLIC HEALTH SERVICE
ENVIRONMENTAL HEALTH CENTER
CINCINNATI, OHIO

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No. PB-260 079
4. Title and Subtitle Effects of Plankton on Water Supplies in the Niagara River Area			5. Report Date 1948 6.
7. Author(s) J. N. Wilson, J. B. Owen			8. Performing Organization Rept. No.
9. Performing Organization Name and Address			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered 14.

15. Supplementary Notes

16. Abstracts Samples of plankton were collected from the Niagara River system and from certain water supplies along the river to determine any effect of plankton on taste and odors in the water supplies of communities bordering the Niagara River. An analysis of the water of Lake Erie and tributaries which enter the river, as a possible source of the problems, is reported. The effects of pollution on the plankton and the occurance of taste-producing organisms are discussed.

17. Key Words and Document Analysis. 17a. Descriptors

17b. Identifiers/Open-Ended Terms

Niagara River
Aquatic microbiology
*Plankton
Algae
*Water analysis
Water quality
Lake Erie
Water supply

17c. COSATI Field/Group 13B

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 16p
	20. Security Class (This Page UNCLASSIFIED	22. Price

FORM NTIS-35 (REV. 10-73) ENDORSED BY ANSI AND UNESCO. THIS FORM MAY BE REPRODUCED USCOMM-DC 8265-P74

EFFECTS OF PLANKTON ON WATER SUPPLIES IN THE NIAGARA RIVER AREA

Late in 1948, a study was undertaken to determine if plankton organisms were responsible for the taste and odor problems encountered in water supplies taken from the Niagara River. Further, it was desired to learn if most of the plankton found in the river water came from Lake Erie or if much of it was produced in creek mouths, bogs, quiet areas along the shore or in polluted areas of the river itself. In order to obtain data relative to the source of pollution, samples were taken at the head of the river, in tributaries and quiet water areas and in transects across the stream. Most of the field work was done in October and November of 1948 but a few samples were taken in August, September and December of 1948, and a few were obtained by personnel of the Niagara Falls water filtration plant in the spring of 1949. The accompanying map shows the sampling stations used.

Many of the stations were sampled only once, while others, such as Ni.-19.4, were represented by numerous samples because of nearness to the base of operations and ease of access. For this reason, seasonal changes which normally occur in plankton composition could not be accurately determined. This fact limits interpretation of other characteristics and changes in the plankton.

Samples were collected by means of a Kemmerer sampler. Most of them were concentrated in the laboratory by the Sedgwick-Rafter method of sand filtration, but a few were concentrated in the field by means of a silk plankton net. All plankton samples were preserved for later study in the laboratory. A Sedgwick-Rafter cell was used for both the qualitative and quantitative studies.

Lake Erie and the Waterfront of Buffalo, N. Y.

In October, 1948, a series of eight Nannoplankton samples was collected at range NI-37.7, in Lake Erie. These samples were taken along a line extending across the outlet end of the lake immediately above the Buffalo water supply intake. All samples showed a predominance of diatoms with total concentrations of organisms somewhat greater near the United States side (see table 1).

Moderate numbers of Synura uvella, the notorious taste-producing yellow-green algae, were taken at sampling points 1,000, 8,500 and 10,500 feet from the United States shore, at range NI-37.7.

In the latter part of October, two samples were collected from Lake Erie near the steel plant at Buffalo, at points 800 and 3,000 feet from shore on range I-E. The sample secured 800 feet from shore had a heavy red precipitate that suggested iron and contained only a few diatoms and green algae, chiefly Asterionella formosa. Diatoms were also predominant at the station 3,000 feet from shore. At this point, however, the population was much higher, 22,150 per liter in comparison to 327 at the 800 foot station.

Niagara River Above the Falls

In November, the Niagara River above Grand Island had a moderate population of diatoms and blue-green algae and a sparse growth of protozoa (see table 2). The green algae found at range Ni-29 and Ni-19.3 (east channel) were a mixture of true plankters and adventitious plankters. The latter are normally attached forms growing on the stream bottom or

TABLE 1

Numbers of Nannoplankton per liter at Range Ni-37.7, Lake Erie,
on October 25-27, 1948

(U. S.) _____ (Canada)

	Distance out from U. S. Side in Feet							
	200	1000	2000	5500	5500	8500	10000	11500
Blue-Greens	693	1188	4785	1040	2132	1250	1887	24
Greens	1295	646	1746	880	715	1280	1770	1200
Diatoms	11050	8576	16980	5810	8470	5490	1770	17500
Protozoa	2500	8510	102	7960	3600	5640	5900	32
Crustacea	23					21		8
TOTAL	15,561	18,920	23,513	15,590	14,917	13,681	11,327	18,764

TABLE 2

Comparison of the Plankton Populations in the East and West Channels of the Niagara River at Grand Island on Nov. 3, 1948.

	Above Gr. Isl.	East Channel		West Channel		
	Ni-32.5	Ni-29	Ni-19.3	Ni-26.7	Ni-20.0	Ni-19.4
	Nov. 3	Nov. 3	Ave. Sept. 22 & Dec. 2	Sept.23	Nov. 5	Nov. 29
Blue-Greens	2,800	1,300	690	2,520	1,700	96
Greens	-	900	11,200*	500	780	771
Diatoms	21,000	11,800	40,500	5,030	18,900	41,100
Protozoa	780	-	1,500	2,000	-	13
	24,580	14,000	53,890	10,050	21,380	41,980

* High count caused by Cladophora swept from bottom and from rocky shores.

along the shores. Strong currents or wave action breaks them loose and disperses them throughout the open water. The heaviest concentration of the adventitious plankter, Cladophora sp. (11,200 per liter) was found at Ni-19.3 (east channel above the water supply intake at Niagara Falls).

Most of the diatoms in this stretch of the river were planktonic, although adventitious ones were found where the current was very strong. The high concentration of organisms in both the east and west channels at ranges Ni-19.3 and 19.4 may be attributed to the usual late fall increase in diatoms. The comparison in this instance is, therefore, between earlier fall samples at Ni-32.5, 29, 26.7 and 20, and the later samples at Ni-19.3 and 19.4. Except for the high concentrations of Cladophora at range Ni-19.3, there was no significant difference in the plankton between the east and west channels of the Niagara River around Grand Island.

The Effects of Tributaries

The tributaries which enter the Niagara River on the United States side are shown on the attached map. These creeks are for the most part widely spaced from one another and have insignificant volumes of flow in comparison to the Niagara River. There is the possibility, however, that certain taste-producers among the plankton of these tributaries might find their way into water supplies along the river.

Plankton samples taken in the tributaries and in the main river nearby, however, fail to show any evidence of such possible effects on water supplies. Table 3, indicates that almost invariably the con-

centration of plankters was higher in the river above the junctions with the tributaries than in the tributaries themselves. The same was true for the Canadian tributaries, Frenchmans, Millers and Usshers, Creeks. All of the latter are small streams with sparse growths of plankton. Of the three, Frenchmans Creek is the only one which could possibly affect water supplies along the United States shore. This creek joins the river at range Ni-32.5, just a short distance upstream from Grand Island. The others flow in near the lower end of Grand Island where they could have little effect on United States water supplies.

The slough at the lower end of Grand Island empties into the river near the junction of the two channels which pass around the island. The plankton in the slough contained, in addition to 22,000 diatoms per liter, over 2,000 Synura uvella. Because of the condition of stagnation in this slough and its location with respect to the water supply intake at Niagara Falls, there is little likelihood of organisms in the area producing tastes or odors in the Niagara Falls water supply. Plankton samples taken in the vicinity of the water intake indicated no movement of these organisms from the slough area.

Effects of Pollution

The effect of pollution on the plankton in the Niagara River was not clear or decisive. Although there is particularly heavy pollution along the east channel, the rate of flow is so high that there is not sufficient time for the plankton to attain any significant increase in numbers while in the river.

TABLE 3

A Comparison of the Number of Plankters per Liter Found in Tributaries and Nearby in the Niagara River

	Buffalo River	Niagara River	Scajaqueda Creek	Niagara River	Niagara River	Two-mile Creek	Tonawanda Creek	Niagara River
	Ni. Bu. 38.7 Oct. 29	Ni. 37.7 Oct. 25-27 200-1000 ft. out	Ni SC 34.4 Nov. 1	Ni. 32.5 Nov. 3	Ni. 29 Oct. 11 & Nov. 3	Ni. TM 27.2 Nov. 1	Ni. TO 26.4 Oct. 29	Ni. 19.3 Dec. 2
Blue-Greens	-	940	568	2764	1310	440	1137	377
Greens	-	870	2460	-	919	3030	11760	195
Diatoms	600	9810	7790	20950	18760	38437	10234	52109
Protozoa	50	5500	3220	780	516	40	379	514
Crustacea	-	10	379	-	-	5700	-	3
TOTAL	650	17,130	14,417	24,494	21,505	47,647	23,510	53,198

The plankton were found at range I-E-800 in Lake Erie near the steel plant at Lackawanna, as well as in the lower part of the Buffalo River. In these places, the pollution acted as a plankton deterrent.

Sewage fungus was found in the plankton samples from several of the United States tributaries. This fungus, Sphaerotilus sp., normally grows attached to objects in the stream but is continually being sloughed off by growth and reproduction of the organism and by current action.

Occurrence of Taste-Producing Organisms

A few specimens of Synura uvella and Uroglenopsis americana (class Chrysophyceae) were present in samples from the more quiescent waters of Lake Erie, Lake Ontario and a slough at the lower end of Grand Island in the Niagara River. These organisms are notorious taste-producers which do not survive in swift water, but the volatile taste-producing oils from disintegrating cells may, under proper conditions, cause tastes in river water supplies.

Although other algae, both greens and blue-greens, were found in some of the samples from time to time above water supply intakes, their concentrations were never high enough to produce taste. Moreover, raw water samples from the Niagara Falls water plant, collected in the spring of 1949, did not show sufficient concentration of organisms to produce tastes.

Niagara River Below the Falls

The plankton of the lower Niagara was essentially similar to that

above the falls. Diatoms and green algae increased to some extent between range Ni-8.0 and the mouth of the river. The diatoms were largely true plankters, whereas, the green alga, Cladophora sp., was the only noticeable adventitious form. Cladophora was most abundant at range Ni-1.0, above Lake Ontario. No serious taste-producers were found.

Summary

Samples of plankton were collected from the Niagara River system and from certain water supplies along the river between August, 1948 and May, 1949. The purpose of this sampling was to determine any effect of plankton on tastes and odors in the water supplies of communities bordering the Niagara River.

Diatoms were the predominant organisms in all samples including those from Lake Erie and Lake Ontario. The most common and characteristic among this group were Asterionella formosa, Tabellaria fenestrata and Fragilaria crotonensis. These are true plankters, that is drifters, which are not found attached to objects or the bottom of a stream or lake. None of these diatoms were found in concentrations sufficient to produce taste in water supplies.

There was, however, a notorious taste-producing organism, Synura uvella, occurring in Lake Erie, at the headwaters of the Niagara River, and in the stagnant slough at the lower end of Grand Island. This organism is fragile and easily broken up in swift water, but volatile oils from the plant body may persist in the water and reach the water supply intakes.

The thread-like green alga, Cladophora sp., normally grows attached to stones or other objects in swift water. Under conditions of violent current action or storms, masses of this alga may be dislodged and dispersed through the water. Highest concentrations of Cladophora, which occurred free in the plankton, were found at range Ni-19.3, in the east channel of the Niagara River above the Niagara Falls water supply intake. There are no records in the literature that this organism produces taste independently in the concentrations observed. However, in conjunction with certain organic wastes in the water, objectionable tastes may result. This aspect of the problem should be studied further. Cladophora may also be responsible for the periodic clogging of filters at water plants.

Conclusions

1. Because of the paucity of samples from some of the stations and the natural seasonal changes in the plankton, the interpretation of results is limited.

2. Diatoms were predominant in most of the samples. These were the true planktonic forms in contrast to adventitious ones which are expected in swift water.

3. There was no significant difference between the plankton in the east and west channels around Grand Island.

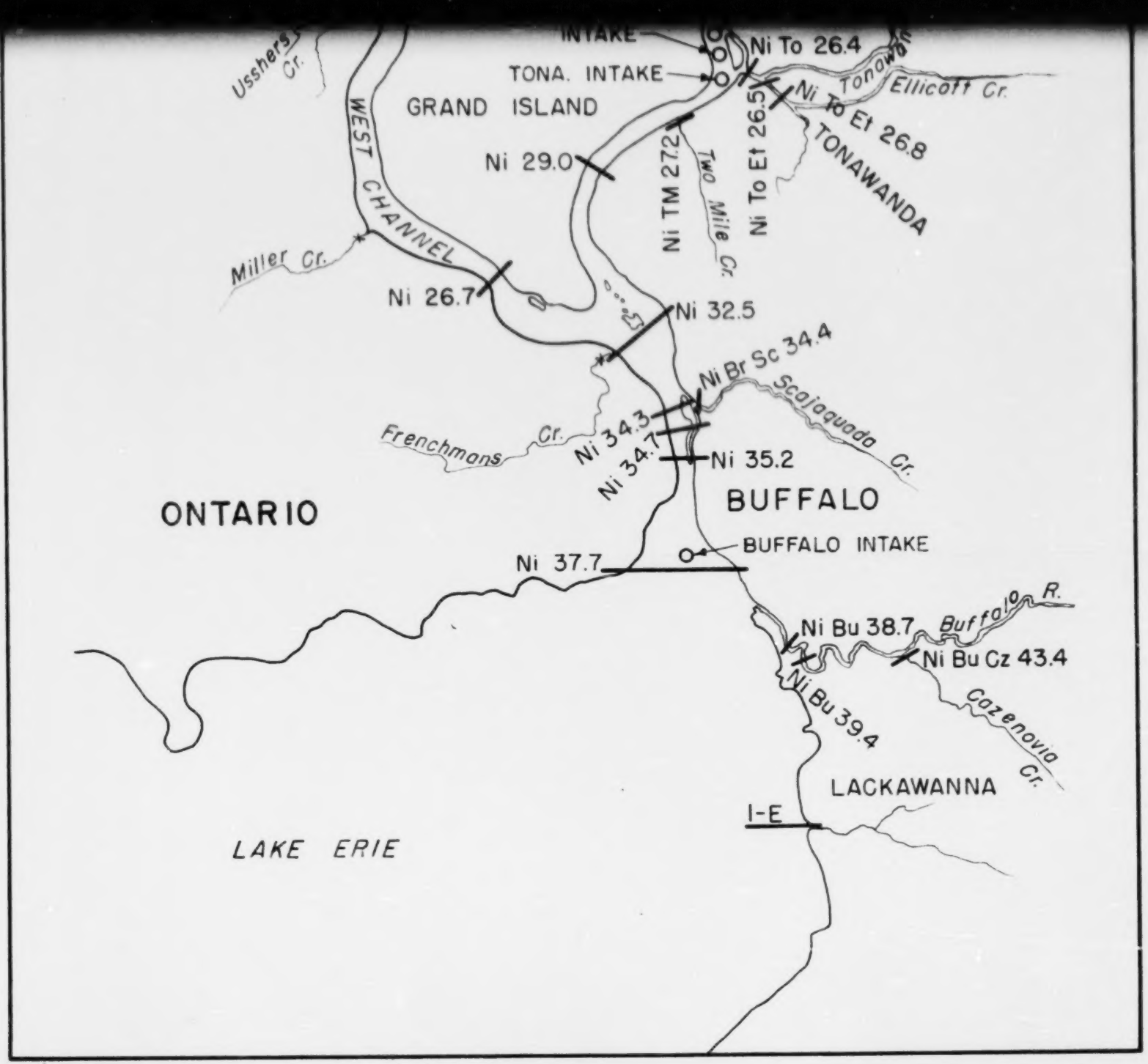
4. The plankton of the tributary streams showed the effects of local pollution in some instances, but there were no significant taste-producing forms found in any of them. Because of the low volume of flow

and small numbers of total plankters in the streams in comparison to the main Niagara River, little effect on the water supplies may be expected from these sources.

5. The effect of Cladophora, normally an attached alga, on the tastes in the drinking water at Niagara Falls was not determined. There is the likelihood that further study on this or similar problems may show that Cladophora can cause tastes in combination with certain organic wastes.

6. The presence of Synura uvella in Lake Erie is a potential taste and odor hazard to all the water supplies along the Niagara River. Although this plankter disintegrates in fast water, volatile oils from its cells may be carried to downstream water supplies.

INTERNATIONAL JOINT COMMISSION
BOUNDARY WATERS POLLUTION INVESTIGATION
PLANKTON SAMPLING STATIONS
NIAGARA RIVER
LAKE ONTARIO
Ni 1.0
YOUNGSTOWN
Ni 2.4
LEWISTON
Ni 6.8
QUEENSTON
Ni 8.0
NEW YORK
NIAGARA FALLS
Cayuga Cr.
Bergholtz Cr.
Ni 19.3
Ni Ca 21.0
Little River
N.F. INTAKE
EAST CHANNEL
LOCKPORT INTAKE
NORTH TONAWANDA
Slough
Ni 20.0
Ni 19.4
NORTH TONA. INTAKE
Ni To 26.4
Tonawanda Cr.
Ushers Cr.
TONA. INTAKE
Ellicott Cr.
GRAND ISLAND
26.5


Ushers Cr.
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Ni To 26.4
TONA. INTAKE
Tonawanda
Ellicott Cr.
GRAND ISLAND
Ni To Et 26.5
Ni To Et 26.8
TONAWANDA
Ni 29.0
Ni TM 27.2
Two Mile Cr.
WEST CHANNEL
Miller Cr.
Ni 26.7
Ni 32.5
Ni Br Sc 34.4
Scajaquada Cr.
Frenchmans Cr.
Ni 34.3
Ni 34.7
Ni 35.2
BUFFALO
ONTARIO
BUFFALO INTAKE
Ni 37.7
Buffalo R.
Ni Bu 38.7
Ni Bu Cz 43.4
Cazenovia Cr.
Ni Bu 39.4
LACKAWANNA
I-E
LAKE ERIE